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CLAIMS:

1. A process for treating a uranium containing feed material, the process comprising :-

contacting the uranium containing material with fluorine gas, the fluorine reacting with the uranium containing material to give uranium fluoride;

feeding the uranium fluoride to a separator stage, the separator stage converting the uranium fluoride into a plasma and/or ionised form, at least part of the uranium being ionised and at least part of the fluorine being non-ionised, the ionised parts being contained in a magnetic field to form a first product stream, the non-ionised parts being withdrawn from the magnetic field to form a second product stream;

the second product stream being recycled to the fluorine gas and uranium containing material contact stage.

2. A process for fluorinating a uranium containing feed material, the method comprising:

contacting the uranium containing material with fluorine gas, the fluorine reacting with the uranium containing material to give uranium fluoride;

the fluorine gas being produced by feeding a fluorine containing material to a separator stage, the separator stage converting the fluorine containing material into a plasma and/or ionised form, at least part of the non-fluorine part of the feed being ionised and at least part of the fluorine part of the feed being non-ionised, the ionised parts being contained in a magnetic field to form a first product stream, the non-ionised parts being withdrawn from the magnetic field to form a second product stream;

the second product stream being fed to the fluorine gas and uranium containing material contact stage.

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3. A process for enriching a uranium containing feed material, the process comprising :

introducing the uranium containing material to a separator stage, the separator stage converting the uranium containing material into a plasma and/or ionised form, at least part of the uranium being ionised and at least part of the non-uranium part of the feed being non-ionised, the ionised parts being contained in a magnetic field to form a first product stream, the non-ionised parts being withdrawn from the magnetic field to form a second product stream;

the first product stream being fed to an enrichment stage, the enrichment stage applying one or more frequencies of electromagnetic radiation to the first product stream, the one or more frequencies being chosen to selectively ionise one or more components of the first product stream, the selectively ionised components being separated from the selectively non-ionised components to form third and fourth product streams respectfully.

4. A process according to any preceding claim in which the uranium containing feed material is a uranium ore.

5. A process according to any of claims 1 to 3 in which the uranium containing feed material is uranium and/or uranium oxide from the reprocessing of uranium and/or uranium containing material previously used in the nuclear fuel cycle.

6. A process according to any preceding claim in which a material removal stage is provided prior to the separator stage with one or more uranium fluoride forms being removed from the process at this stage.

7. A process according to any preceding claim in which the first product stream comprises uranium metal.

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8. A process according to any of claims 1 to 6 in which the first product stream comprises uranium and/or plutonium and/or fission products in elemental form.
9. A process according to any preceding claim in which the second product stream is predominantly fluorine.
10. A process according to any preceding claim in which the second product stream is processed prior to feeding to the fluorine/uranium containing material contact stage, the process comprises cleaning the fluorine to remove other species.
11. A process according to claim 2 or any claim depending therefrom in which the fluorine containing material is a uranium fluoride and preferably is uranium hexafluoride.
12. A process according to claim 2 or any claim depending therefrom in which the second product stream supplements fluorine being recycled from a separator provided in a process according to claim 2.
13. A process according to claim 3 or any claim depending therefrom in which the uranium containing feed material is one or more uranium fluorides and particularly uranium hexafluoride.
14. A process according to claim 3 or any claim depending therefrom in which the first product stream is neutralised prior to feeding to the enrichment stage.
15. A process according to claim 3 or any claim depending therefrom in which the one or more frequencies of electromagnetic radiation applied are selected to ionise the

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^{235}U containing components in preference to the ^{238}U containing components.

16. A process according to claim 3 or any claim depending therefrom in which the third product stream is separated from the fourth product stream by electrostatically attracting the third product stream to a collection location.

17. A process according to claim 3 or any claim depending therefrom in which the third product stream is enhanced in ^{235}U relative to the first product stream.

18. Apparatus for treating a uranium containing feed material, the apparatus comprising :-

a first unit in which the uranium containing material is contacted with fluorine gas, the fluorine reacting with the uranium containing material to give uranium fluoride;

a second unit forming a separator stage to which the uranium fluoride is fed, the separator stage including a plasma and/or ion generator to convert the uranium fluoride into a plasma and/or ionised form, at least part of the uranium being ionised and at least part of the fluorine being non-ionised, the separator stage further including magnetic field generating means to form a magnetic field to contain the ionised parts and form a first product stream, the separator stage still further including means for removing non-ionised parts from the magnetic field, the non-ionised parts being withdrawn from the magnetic field to form a second product stream;

the second product stream being recycled to the first unit in which the fluorine gas and uranium containing material are contacted.

19. Apparatus for fluorinating a uranium containing feed material, the apparatus comprising:

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a first unit in which the uranium containing material is contacted with fluorine gas, the fluorine reacting with the uranium containing material to give uranium fluoride;

a second unit forming a separator stage, the fluorine gas being produced in the separator stage by feeding a fluorine containing material to the separator stage, the separator stage including a plasma and/or ion generator to convert the fluorine containing material into a plasma and/or ionised form, at least part of the non-fluorine part of the feed being ionised and at least part of the fluorine part of the feed being non-ionised, the separator stage further including magnetic field generating means, the ionised parts being contained in a magnetic field produced by the magnetic field generating means, to form a first product stream, the separator stage still further including means to remove non-ionised part from the magnetic field, the non-ionised parts being withdrawn from the magnetic field to form a second product stream;

the second product stream being fed to the first unit in which fluorine gas and uranium containing material are contacted.

20. Apparatus for enriching a uranium containing feed material, the apparatus comprising :

a first unit, forming a separator stage, into which the uranium containing material is introduced, the separator stage including a plasma and/or ion generator to convert the uranium containing material into a plasma and/or ionised form, at least part of the uranium being ionised and at least part of the non-uranium part of the feed being non-ionised, the separator stage further including magnetic field generating means for producing a magnetic field, the ionised parts being contained in the magnetic field to form a first product stream, the separator stage still further including means to remove non-ionised parts from the magnetic field,

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the non-ionised parts being withdrawn from the magnetic field to form a second product stream;

a second unit, forming an enrichment stage to which the first product stream is fed, the enrichment stage including a source of electromagnetic radiation, preferably a laser, so as to apply one or more frequencies of electromagnetic radiation to the first product stream, the one or more frequencies being chosen to selectively ionise one or more components of the first product stream, the enrichment stage further including means to separate the selectively ionised components from the selectively non-ionised components to form third and fourth product streams respectfully.

21. A process for purifying a uranium containing material, the process comprising:

feeding a uranium containing material to an enrichment stage, the enrichment stage applying one or more frequencies of electromagnetic radiation to the feed thereto, the one or more frequencies being chosen to selectively ionise one or more components of the feed thereto, the selectively ionised components being separated from the selectively non-ionised components to form third and fourth product streams respectfully;

one or both of the product streams being fed to a fluorinating stage in which the uranium containing material in the product stream is contacted with fluorine gas, the fluorine reacting with the uranium containing material to give uranium fluoride;

the fluorinated uranium and other components of the product stream being fed to a separation stage in which the uranium fluoride is separated, to give a fifth product stream, from one or more other components of the product stream which forms a sixth product stream.

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22. A process according to claim 21 in which the uranium containing material fed to the enrichment stage is atomic uranium in gaseous and/or vapour form and in non-ionised form.

23. A process according to claim 21 or claim 22 in which the other components of the product stream are one or more other metals such as iron.

24. A process according to any of claims 21 to 23 in which the uranium fluoride is separated from the one or more impurities also in fluoride form, based on differences in volatility.

25. Apparatus for purifying a uranium containing material, the apparatus comprising:

a first unit forming an enrichment stage to which a uranium containing material is fed, the enrichment stage including a source of electromagnetic radiation, preferably a laser, to apply one or more frequencies of electromagnetic radiation to the feed thereto, the one or more frequencies being chosen to selectively ionise one or more components of the feed thereto, the enrichment stage further including means to separate the selectively ionised components from the selectively non-ionised components to form third and fourth product streams respectfully;

a second unit forming a fluorinating stage, to which one or both of the product streams are fed in which the uranium containing material in the product stream is contacted with fluorine gas, the fluorine reacting with the uranium containing material to give uranium fluoride;

a third unit forming a separation stage, the fluorinated uranium and other components of the product stream being fed to the separation stage in which the uranium fluoride is separated, to give a fifth product stream, from

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one or more other components of the product stream which forms a sixth product stream.

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